

What is claim d is:

1. A DC/DC converter comprising:

a voltage converting circuit connected between an input terminal and an output terminal for outputting an output voltage and a switch current detection signal;

a fast transient response circuit for receiving the output voltage, control voltage, and switch current detection voltage, and outputting a second control operation determination signal;

a step-up and step-down operation determining circuit for receiving the output voltage, the control voltage, and input voltage, and outputting a first control operation determination signal;

a voltage comparator for receiving the output voltage, the control voltage, and the second control operation determination signal, and outputting a switch condition signal; and

a switch control circuit for receiving the switch condition signal, the first control operation determination signal, and the second control operation determination signal, and outputting a switch control signal,

wherein the switch control signal is fed into the voltage converting circuit, and a feedback circuit is composed.

2. The DC/DC converter of claim 1,

wherein the voltage converting circuit is composed of

series connection of:

- a first switch circuit;
- an inductor;
- a second switch circuit; and
- a smoothing capacitor.

3. The DC/DC converter of claim 2,

wherein the first switch circuit operates to connect the input terminal and inductor all the time when the voltage converting circuit is in step-up operation.

4. The DC/DC converter of claim 2,

wherein the second switch circuit operates to connect the inductor and the smoothing capacitor all the time when the voltage converting circuit is in step-down operation.

5. The DC/DC converter of claim 2,

wherein the fast transient response circuit comprises:

- a load judging circuit for receiving the switch current detection signal output from at least one of the first switch circuit and the second switch circuit, and the output voltage output from the smoothing capacitor, detecting an output load region, and outputting a load region detection signal;

- an output voltage change detecting circuit for comparing the control voltage and the output voltage, detecting the change

of the output voltage, and outputting an output voltage change detection signal; and

a control operation determining circuit for outputting the second control operation determination signal for determining a control mode of the switch control circuit by the load region detection signal and the output voltage change signal to the switch control circuit and the voltage comparator.

6. The DC/DC converter of claim 1,

wherein the voltage comparator comprises:

a comparator for receiving the output voltage and the control voltage, comparing, and outputting an error voltage;

an oscillating circuit for outputting a reference triangular wave signal based on the second control operation determination signal; and

a switching condition determining circuit for comparing the error voltage and the reference triangular wave signal, and outputting the switch condition signal.

7. The DC/DC converter of claim 1,

wherein the second control operation determining signal is a signal for determining the operation mode of either PWM or PFM.

8. The DC/DC converter of claim 6,

wherein the oscillating circuit changes an oscillation frequency depending on the second control operation determination signal, and also executes to operate to change the switch frequency or time ratio of the switching condition determining circuit.

9. The DC/DC converter of claim 1,

wherein the voltage converting circuit comprises:

a first cascade connection circuit composed of first switch circuit and first inductor;

a second cascade connection circuit composed of second switch circuit and second inductor; and

a smoothing capacitor,

wherein the first cascade connection circuit and the second cascade connection circuit are connected in parallel, and

wherein the output of the first cascade connection circuit and output of the second cascade connection circuit are put into the smoothing capacitor.

10. The DC/DC converter of any one of claims 1 to 9, wherein the operation functions by selecting either one of two operation modes defined by the value of the threshold current of the whole load region set by the load current value and the output voltage value.

11. The DC/DC converter of any one of claims 1 to 9, wherein the operation functions by selecting either one of two operation modes defined by the value of one or two or more threshold currents of the whole load region set by the load current value and the output voltage value.

12. The DC/DC converter of claims 5, wherein the PWM control is operated regardless of the output current and the output voltage in the condition of detection of change of the output voltage having a voltage difference more than a specified value in the output voltage as compared with the target output voltage corresponding to the control voltage in the output voltage change detecting circuit, and

the operation mode determined by the load region detection signal out of the two operation modes is executed in the condition not having the voltage difference more than the specified value and not detecting the change of the output voltage.

13. The DC/DC converter of claim 5, wherein the fast transient response circuit has an output fluctuation suppressing function for suppressing the fluctuation of the output voltage when the change of the output voltage in the output voltage change circuit is changed from undetected state

to detected state or from detected state to undetected state.